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BY MULTISTAGE SAMPLING

GSFC Identification Number 2306A

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**Extensive Inventory of Forest Resources
by Multistage Sampling**

GSFC Identification Number 2306A

Principal Investigator: Robert C. Aldrich

**Coinvestigators: Robert W. Dana
Edwin H. Roberts**

STATEMENT OF PROBLEMS:

1. One major problem encountered in this investigation has been the time lapse between a LANDSAT overpass and the listing of the data in the LANDSAT catalog. The time lapse has been averaging 2 1/2 to 3 months. This delay, plus the time required to order and receive data from EROS, seriously limits work on temporal data within the time frame of our contract.

2. The Principal Investigator and Coinvestigators were transferred by the Forest Service from Berkeley to Fort Collins, Colorado, on June 15, 1976. This move has seriously disrupted the continuity of this research effort and may result in a 2- to 3-month delay in completion of our contract.

ACCOMPLISHMENTS:

Photo Interpretation, Mapping, and Photogrammetry:

1. A random sample of 50 plots was selected from the 472 total to check reliability of sample plot locations plotted on the 1:125,000 scale map overlay. The distances between the original locations on 1:24,000 map sheets and locations plotted on the overlay using Numonic Calculator-measured coordinates were checked using a Zoom Transfer Scope (ZTS). The RMSE for the sample was 14.88 ± 10.13 meters. Considering instrument limitations and the geometric limitations in LANDSAT data, the coordinate locations were considered well within the requirements of our experiment.

2. Interpretation and mapping of the water resources in three counties was completed. The multistage inventory of water resources began with first-level information from Band 7 of LANDSAT scenes 2310-15060 and 2310-15062, November 28, 1975. Length of streams and area of rivers, lakes, reservoirs, estuaries, and other bodies of water were estimated for each 1000-meter UTM cell and recorded.

There were 1691 cells. The estimated water data were stratified into seven strata by computer and a random sample selected in each strata to check on 1:120,000 CIR photographs. There were 420 samples in the three counties. Each sample cell was examined on CIR photographs and 1:24,000 map sheets using a ZTS. Stream lengths were measured with a planimeter and areas of water were measured by dot grid. Appropriate conversions were made to meters and hectares. In addition, each stream or body of water was classified by broad resource class, size class, accessibility class, and utility class. The data were punched for computer analysis. From the analysis we hope to compute the total water resource in each county and the total by broad resource class with statements of statistical reliability. We also hope to compute a regression for the relationship between water measured on LANDSAT and water measured on CIR photography which could be useful for water resource surveys.

3. Forest assessment has been delayed due to problems and delays in obtaining suitable LANDSAT data for interpretation. Hard-copy imagery produced by the U.C. Berkeley Remote Sensing Research Program for the May 1975 LANDSAT data was received. The resolution of this enhanced data, produced directly from LANDSAT CCT's is a big improvement over 4th generation images produced by the ASCS Photo Laboratory. However, one serious problem which must be overcome is that water cannot be reliably separated from other resources on the May image. Attempts to combine Band 7 for the November 1975 LANDSAT scene with Bands 4 and 5 of the May scene were unsuccessful because of misregistration. We will examine images made by U.C. for the October LANDSAT scene to see if interpretation can be improved.

Computer Analysis, Mapping, and Photogrammetry:

1. A simple empirical distribution routine was used to produce line printer maps for portions of the nine-county Virginia test site. Several iterations of these maps have been produced. Interpretations of each iteration have been used to establish input levels for the next iteration. The interpretation was done on a ZTS by comparing the printer map with small-scale CIR photographs. The ability of the ZTS to optically stretch the CIR image was used to match the photo detail with the line printer output.

2. No new land cover categories have been suggested by the classification results to date. However, use of the unsupervised classification routines available at Colorado State University in Fort Collins may provide additional information. We will pursue this possibility once we have become established in Fort Collins.

3. Images for the LANDSAT October 23, 1975, overpass have been produced for us by the U.C. Berkeley Remote Sensing Research

Program on their "Imaging Gang Optical Recorder (IGOR)." Several tapes for adjoining scenes were combined and then reformatted to produce a single tape for the U.C. group to work with. We had no opportunity to examine this new data before this report.

Data Standardization and Quantification:

1. The four-band radiometer to be used in aircraft radiance measurements was interfaced to a multichannel digital data logger. This data system, which produces its output on computer-compatible tape, was rack-mounted in the Forest Service Aero Commander and successfully tested on April 14, 1976.
2. The viewing port atop the aircraft was completed and a new irradiance meter was constructed to provide measurements of downwelling sunlight for the digital data system. The irradiance meter is a compact box which accepts the broad-band light from a fiber optics light guide and houses a filter wheel for spectral separation of the light directed on a silicon diode detector. This package also houses batteries and an amplifier circuit for 0-3V output.
3. The amplifier box for ground-based radiance measurements was modified for full d.c. operation without reliance on an a.c. inverter. This required the installation of a low-power 5V panel meter and a 12V to ± 15 V d.c. to d.c. convertor.
4. All systems operated without significant problems during flights over the Virginia LANDSAT test site on April 23 and 24.

Aircraft and Ground Data Acquisition:

A major effort of airborne radiance measurements had been planned for the LANDSAT-2 pass over Virginia on April 20, 1976. Two men were sent in advance of the California-based aircraft to determine the likelihood of clear weather for good LANDSAT coverage and to take ground-based data at the time of overpass. On the morning of the 20th, they gave the go-ahead for the pilot and two crewmen to proceed with the airborne equipment to Virginia. This approach greatly reduced the chances of wasting man-hours and money on a field trip to gather data which corresponds only to cloud-covered LANDSAT imagery. While the aircraft traveled cross-country, the advance crew was able to ground-check the prospective flight lines.

On April 23 and 24 the aircraft was ready and five sites were flown. Three sites are on the coast, one is near the center of the Virginia test site, and one is near the western edge. On each day, one site was manned for ground-measured irradiance. About 160 km of flight line were flown between 0900 and 1030 hours, EST. The data will be unpacked from the tapes, processed for determination of reflectance values, and eventually compared with LANDSAT radiance values.